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EDITORIAL

IT is our pleasant duty in this number to welcome the many overseas visitors who will be attending the Congress of Anæsthetists in London next September. This Congress will be the twenty-sixth organized by the International Anæsthesia Research Society and the International College of Anæsthetists, and will be under the Honorary Presidency of Dr. I. W. Magill. It has been the custom to associate these gatherings and occasions with the name of one of the great in anæsthesia. This year tribute is being paid to British anæsthesia as the Congress will be "In honour of Dr. H. Edmund G. Boyle".

The first of these Congresses was held in Columbus, Ohio, at the end of October, 1922. The theme on that occasion was the "Teaching of Anæsthesia and the Development of the Hospital Anæsthetic Service". The editorial in *Current Researches*, urging attendance at the Congress, commenced with the clarion call, "Why be satisfied when you can be more successful?" Why indeed, and as in these days of lightning progress and advance it is more than ever difficult to keep abreast of one's subject but just as necessary for success to do so, it is to be hoped that the present Congress will be worthily supported and

widely attended. That first Congress in the far-off days of the early twenties must have been a notable affair, and among the list of those present are to be found such names as Arthur E. Guedel and E. J. McKesson, and the Secretary and Organizer was F. H. McMechan. It is a tribute to a very notable anæsthetic combination that the present Congress will have been largely planned and devised by Mrs. Laurette McMechan.

The last similar function in this country was in 1926, when the International Anæsthesia Research Society held a joint meeting with the British Medical Association Section of Anæsthetics at Nottingham. Our American visitors were then offered a trans-Continental trip which was certainly in the grand manner. After arriving at Liverpool they visited Dublin, Killarney, " with a drive through the many weird mountain defiles and along the shores of the beautiful Irish Lakes ", Cork (undoubtedly to kiss the Blarney Stone), Belfast and other parts of Northern Ireland, Stranraer, Glasgow, the Scottish Lakes, Edinburgh, London (for seven days), Nottingham, Paris, Amsterdam, Hamburg, Copenhagen, Stockholm, Frankfurt, down the Rhine to Cologne and thus to Bremen and home. The total cost for this memorable occasion was a mere $1195, which would come in those days to about £250. It is sad to think that not many of our visitors will be able to complete a very much smaller programme at anything approaching the same figure. We can only hope that there will be other compensations which will make this occasion as memorable and even more successful.

ELECTRO-ENCEPHALOGRAPHIC PATTERNS PRODUCED BY THIOPENTAL SODIUM DURING SURGICAL OPERATIONS: DESCRIPTION AND CLASSIFICATION

By DONALD K. KIERSEY, REGINALD G. BICKFORD *and* ALBERT FAULCONER, JR.

IT is known from studies on animals (Bickford, 1950) that thiopental (Pentothal) sodium anæsthesia produces characteristic changes in the brain-wave pattern in relation to the depth of anæsthesia. In man, Brazier has demonstrated that a similar relationship holds for the early stages of anæsthesia. The object of our investigation was to study the brain-wave patterns under the practical conditions of the operating room and at a depth beyond that which was achieved under experimental conditions by Brazier. An attempt has been made to classify the electro-encephalographic (EEG) changes in relation to deepening thiopental anæsthesia in a manner analogous to that of Courtin, Bickford and Faulconer (1950) for ether so as to produce a scale of anæsthetic depth that might be of practical value to the clinical anæsthetist.

The need for such a guide to depth is actually greater than in the case of ether anæsthesia because (1) clinical signs of depth in barbiturate anæsthesia are indefinite and (2) when barbiturate anæsthesia is used in combination with curare the most reliable sign, respiratory activity, is invalidated. The subjects, who agreed to have this study made, were patients undergoing surgical treatment for varicose veins of the legs.

Preliminary investigations of different areas of the cortex revealed that the characteristic rhythms produced by thiopental were present in all parts of the cortex. It was therefore decided to confine this study to the observations of changes in one area only.

APPARATUS

A two-channel ink-writing oscillograph was used and recording was made on one channel only. The high and low frequency filters were set to give approximately 50 per cent cut off at 0.75 cycle and at 45 cycles, while the response fell by 90 per cent at 0.4 cycle and 80 cycles respectively.

The second channel was not used for this study. Respiratory minute volume was registered by means of a volume-displacement gas meter connected in series in the breathing circuit and designed to operate an electro-mechanical ink-writing signal by opening and closing a dry battery circuit during the passage of each 500 ml. through the meter.

The electro-encephalographic electrodes were of the needle variety and provided with screened leads. Frontal and occipital leads were used. The frontal lead was placed over the frontal prominence about 1 inch from the midline and the occipital lead was placed directly behind, about 1½ inches anterior to the occipital protuberance. A ground lead was attached over the mastoid process. In the early stages of the investigation troublesome interference from diathermy and other electrical apparatus was encountered. In an attempt to overcome this difficulty the technic suggested by Prast (1948) of introducing 50,000 ohm resistors in the grid leads of the input tubes of the amplifier was used successfully.

MATERIAL AND PROCEDURE

A total of 65 records was made on 24 and 41 female subjects whose ages ranged from 14 to 74 years (average 47). Recordings were, in all cases, taken from the immediate pre-anæsthesia period and continued in most instances until the completion of the operation. In 3 cases recordings were continued into the recovery period. Patients were given $\frac{1}{6}$ grain (11 mg.) of morphine sulphate and 1/150 grain (0.43 mg.) of atrophine sulphate one or two minutes before induction of anæsthesia by the intravenous route.

The operation performed was the same in all cases and was a stripping procedure applied to the greater saphenous veins in one or both legs. Multiple incisions of the skin made during the operation provided adequate opportunities of studying the effects produced in the patient by this intense peripheral stimulation.

The actual procedure of stripping a vein requires a deep level of thiopental anæsthesia as the operation has been known to initiate laryngeal spasm when performed if the patient is carried at light levels. During the early part of this investigation one case of laryngeal spasm of short duration was encountered; its occurrence was attributed to inexperience in the use of the method. An oropharyngeal airway was used in all cases.

Anæsthesia was induced and maintained with 2.5 per cent solution of thiopental sodium. A continuous supply of oxygen was maintained throughout.

DESCRIPTION OF EEG CHANGES

Statements regarding frequencies are based on studies made with the Grey Walter frequency analyser. The first noticeable effect of thiopental sodium on the EEG is a break up of the resting rhythm into a fast spiky pattern of

greatly increased voltage. The predominant frequencies of this pattern lie between 20 and 30 cycles per second. This effect is seen very early in the administration; it may be expected to appear within one minute of injecting as little as 50 mg. of the drug and corresponds to the changes reported by Brazier and Finesinger (1945). Increasing dosage increases the overall amplitude of the pattern without altering the frequency during this phase. In the early stages the subject is awake but feels drowsy and euphoric. The exact moment at which he loses contact with the environment varies from patient to patient, and up to a point seems to depend on the strength of his effort to maintain consciousness. It is not constantly characterized by any special change in the pattern and may occur before the appearance of the slower wave forms to be described next.

The appearance of the slower waves was not found to coincide with loss of consciousness in all cases as was previously stated by Finesinger and co-workers (1947) and Tucci and co-workers (1949). Conditions of recording may explain this difference. After consciousness is lost, as evidenced by either cessation of counting or failure to respond to the spoken command, the eyelash reflex and eyelid tone remain active and a brisk withdrawal reaction is evinced in response to painful stimulation of the skin. As reflex activity becomes more sluggish and consciousness is lost or greatly dulled, the pattern begins to take on a different appearance due to the admixture of slower frequency components and often a further increase in amplitude over the preceding pattern. The slower waves vary greatly in frequency from 1 per second to 5 to 7 per second and show a correspondingly varied amplitude. As anæsthesia progresses so does the tendency to slowing of the waves. Superimposed on and intermingled with the slow

waves is a well-marked faster activity that approximates 10 cycles per second. This stage gives way to the next which is marked by a significant change consisting of an inhibition of electrical activity for periods which are short at first but later come to dominate the record, so that short complexes may appear isolated by many seconds of relative cortical inactivity. As administration of the drug is continued the periods of inactivity become longer and the amplitude of the isolated complexes smaller.

CLASSIFICATION OF EEG PATTERNS

First Pattern (Fast). This pattern is characterized by high-amplitude, fast spiky activity of mixed frequencies varying between 10 and 30 cycles per second with the predominant frequency near 20 cycles per second. The amplitude varies greatly; short runs of two, three, or more waves with an amplitude between 75 and 80 microvolts are characteristically preceded and followed by similar runs of lower amplitude; single elements of either of these groups are interspersed in a random manner at frequent intervals. This pattern is demonstrated in the tracing marked " first " in figure 1.

Second Pattern (Complex). This pattern is a complex of many frequencies but differs from the preceding because of the presence of predominantly slower wave forms of very irregular contour and random occurrence. The range of their frequency variation is wide as can be seen in the tracing marked " second " in figure 1, where the slowest waves occupy a time interval of nearly two seconds. There is also much variation in voltage, the larger and predominating waves representing close to 150 microvolts. Superimposed on these slower waves and occupying the intervals between them is a much faster activity rather

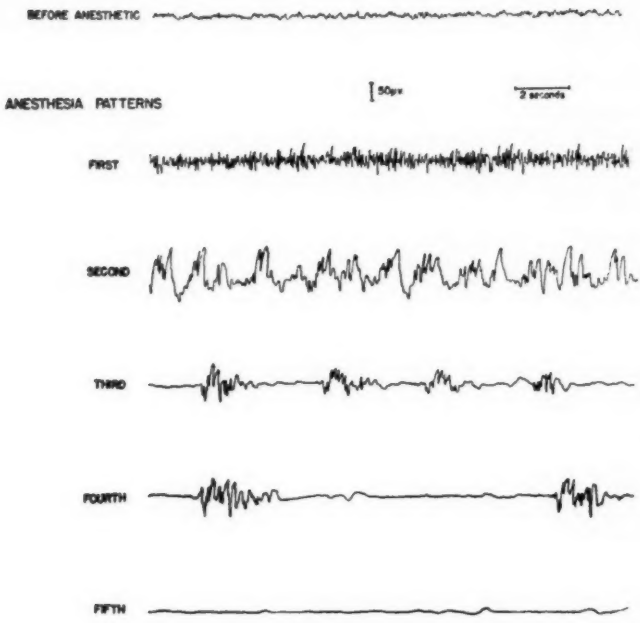

FIG. 1.
Electro-encephalographic patterns in deepening thiopental anæsthesia.

spikey in character and irregular in amplitude. The frequency of this element is near 10 cycles per second and the amplitude is comparable to that seen in the first pattern.

Third Pattern. This is characterized by a progressive suppression of cortical activity taking the form of short periods of relative quiescence that separate groups or bursts of waves. These bursts are frequently made up of two distinct elements. The first appears abruptly and consists of a short series of high-voltage waves of a frequency usually found to be near 10 cycles per second and continuing for about one second; the second element follows immediately

in the form of two or more slow waves at a frequency of near 2 per second and tailing off into the next suppression phase. In other instances the burst may have no slow-wave component or the fast element is superimposed on the slow waves. The complexes in the tracing marked " third " in figure 1 all show a slow-wave component. The whole complex occupies a time interval of two or more seconds. As there is a tendency to regular discharge, further classification is made on the basis of the duration of the periods of inactivity. This pattern is defined as one in which the intervals are recognizable but do not exceed three seconds in length.

Fourth Pattern. The difference between this and the preceding pattern is in the duration of the periods of cortical inactivity which are defined as lasting between three and ten seconds. The amplitude of the waves in the periods of activity may be slightly less than in the previous level but the frequency characteristics remain unaltered.

Fifth Pattern. In this pattern periods of inactivity do not appear more frequently than once every ten seconds and there is further reduction in the amplitude of the components which may, for all components, fall below 25 microvolts. The frequency of the waves is the same as that found in the active phases of the preceding pattern.

During the transition from one pattern to another there is usually a mixture of the characteristic frequencies of both patterns. This is especially noticeable in the persistence of fast waves in the second pattern, and in fact an activity of 10 cycles per second or faster can be followed through into the fifth pattern where it makes up part of the active elements.

Many of our patients were carried at a level of anæsthesia that was too light to bring up the full range of

patterns described; yet in all our records the sequence in which the changes occurred as anæsthesia became deeper or lighter was observed to be the same.

EFFECT OF CURARE

To determine whether the intravenous administration of curare produced a change in the EEG pattern during thiopental anæsthesia the following procedure was carried out on 7 patients. When the intermittent dosage of thiopental required to maintain an even level of anæsthesia and a constant EEG pattern was determined for the patient, d-tubocurarine chloride was given in divided doses while the administration of thiopental was continued at the predetermined rate. When the patient was curarized to the extent of reducing his respiratory minute volume by 50 per cent or more the administration of curare was discontinued. In no case was any change in the EEG pattern produced in this manner. Figure 2 shows cuttings from the

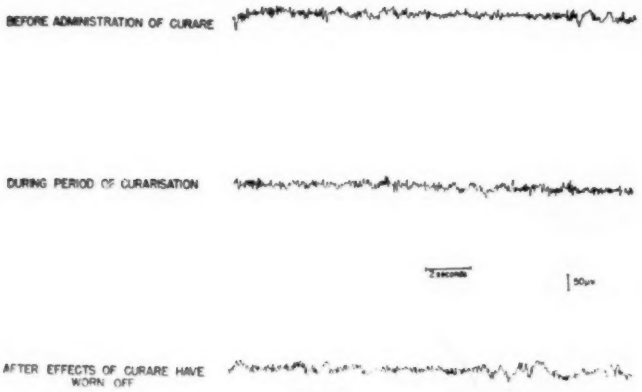

FIG. 2.

Electro-encephalographic patterns during thiopental anæsthesia showing absence of any change in response to curarization.

record of such a case. The first tracing was recorded just before the administration of curare, at which time the respiratory minute volume was 9 litres. The second tracing was recorded during the period of curarization, the spontaneous respiratory minute volume having fallen to 2.5 litres. The third recording was made some eighteen minutes later when the respiratory minute volume had returned to 9 litres. If curarization is prolonged without compensation for respiratory depression being made by aiding respiration one would expect changes characteristic of hypercapnia and anoxia to appear in the EEG. This condition was avoided in the present investigation.

In patients followed to recovery of consciousness the changes seen were, as was observed by Brazier (Brazier et al., 1945), less clear-cut although they mirrored fairly closely those seen during induction as regards frequency and pattern form; less evidence of alteration in voltage was noticed and the initial great increase and subsequent fall from the late first pattern to the late second pattern was not seen when the changes were observed taking place during recovery.

RELATION OF EEG PATTERN TO CLINICAL SIGNS

It is not proposed to try to correlate rigidly the electro-encephalographic changes described with detailed observations of clinical signs of anæsthesia as it is known that these signs in themselves are inconstant; however, it has been possible to make some generalizations in this respect.

During the period of the first pattern, consciousness, though dulled, is retained in the early phases. The eyelash reflex or response of the eyelid to gentle stroking of the lashes is brisk; there is no loss of eyelid tone, and muscular

reaction to painful stimulation is quick and purposeful. As this stage advances and usually before the appearance of the slow waves characterizing the next stage, consciousness is lost, the patient if counting will cease to do so, or he will fail to respond to a spoken question or command. Occasionally he will continue to count for a short period of time, if prompted, even after the appearance of the second pattern.

The second pattern is accompanied by the loss of consciousness and reduced reflex activity; the withdrawal reaction to painful stimuli is abolished; the eyeballs become centred and immobile; eyelid tone and eyelash reflex are lost, the reflex disappearing before all eyelid tone is gone; and the pupil reaction to light remains brisk. This stage is usually accompanied by a slight fall in blood pressure and there may be some depression of respiration. When the pattern is well established the majority of patients will tolerate the placing of skin clips, incision of the skin, retraction of the edges of a wound and the introduction of the pharyngeal airway. Late in this stage, but before the onset of pattern 3, stripping of veins can be carried out without fear of initiating laryngeal spasm or any sign suggesting intolerance of this interference.

As the third pattern appears, reduction of respiratory minute volume becomes more marked. This respiratory depression increases progressively through the fourth and fifth patterns and during the latter it may be necessary to aid the respirations. The pupil has been found to retain its reaction to light throughout all stages observed; its size will have been influenced by the morphine administered before anæsthesia, which tends to produce myosis. Mydriasis was not recorded in any case at any period of anæsthesia. The type of operation performed did not permit the making of any observations on abdominal relaxation.

When operations requiring considerable muscular relaxation are performed under thiopental anæsthesia, recourse is made to the use of the curare-like drugs in order to obtain the desired relaxation. Such drugs have a potent depressive effect on respiratory movements and so render the observations of these movements unreliable as a guide to depth of thiopental anæsthesia; thus, as noted in the introduction to this paper, one is deprived of the most reliable sign. Under such circumstances reference to the EEG pattern should prove to be of real value since it allows the depth of anæsthesia to be assessed in the presence of curare.

In considering the value of clinical signs in thiopental anæsthesia Adams (1944) noted that a certain sign denoting adequate anæsthesia may be unreliable in one case and not in another. Although it is not claimed that in 100 per cent of cases EEG changes alone can tell whether a patient will tolerate an incision of the skin (which is usually the most acutely painful stimulus during any operation), observation and interpretation of such changes as an index of anæsthetic depth have proved of greater value than any other single sign we have observed.

SUMMARY

Electro-encephalographic recordings were made in the operating room on 65 patients undergoing thiopental (Pentothal) anæsthesia. The changes in frequency and amplitude that occurred during anæsthesia are described. They are classified into five distinct patterns representing progressively deepening levels of anæsthesia. An effort is made to correlate these patterns with commonly observed clinical signs denoting anæsthetic depth. Curare was found to produce no alterations in the electro-encephalographic pattern during thiopental anæsthesia. It is therefore felt

that when a combination of these agents is used, observation and interpretation of the electro-encephalogram is a most valuable index of anæsthetic depth.

We are indebted to Dr. T. T. Myers and Dr. K. A. Lofgren of the Section on Peripheral Vein Surgery and Postoperative Care for their kind co-operation in this investigation.

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THE TOXICITY OF XYLOCAINE

By A. R. HUNTER

THE local anæsthetic drug Xylocaine was discovered some years ago by Lofgren (1948), and has been used quite extensively in clinical anæsthesia in Sweden. It has proved to have the particular advantage that the onset of anæsthesia is rapid, yet its duration is much longer than that with any other useful drug of this type. If therefore it is found on extended investigation that the toxicity of Xylocaine is sufficiently low to permit of the employment of clinically useful quantities of the drug, this agent may well come to be regarded as the drug of choice for all major operations under local anæsthesia. It is thus a matter of some importance that the toxicity of Xylocaine relative to that of other agents should be established.

It is currently agreed that the maximum safe dose of procaine, which is the standard local analgesic drug of the moment, is 1.0 g. per hour. Gordh (1949) who carried out the early clinical studies of the use of Xylocaine suggests a maximum dose of 0.5 to 1.0 g. for this drug and states that the toxicity of the two drugs is about equal. Carnegie and Hewer (1950) in their clinical study of the drug also accepted 1.0 g. as the maximum safe dose. They did not observe any toxic effects. Gordh, however, had two cases in which convulsions developed. In one of these a total dose of 1.35 g. had been given, while in the other 3.0 g. had been injected. Both patients recovered with suitable treatment. From these reports it would appear that a maximum dose of 1.0 g. gives an ample margin of safety. In the course

of a limited clinical study of the action of the drug the author observed two somewhat disquieting incidents. On one occasion a woman who received 0.85 g. of Xylocaine, mostly in 0.5 per cent solution for anterior intercostal block and wound infiltration, together with 0.9 g. of thiopentone for a gastrectomy lasting $2\frac{1}{2}$ hours, was unexpectedly pale and ill-looking for the first four hours after operation. The second incident was even more disturbing. During the course of the infiltration of the back and neck with $\frac{1}{2}$ per cent Xylocaine prior to cervical laminectomy the patient, who was already under nitrous oxide and oxygen anæsthesia, became rigid and apnoeic. Simultaneously the pulse rate rose to 120 per minute. After about 5 minutes artificial respiration the patient recovered and no further disturbances of the kind appeared during the operation. This upset was almost certainly the result of the inadvertent intravenous injection of a small quantity of the local anæsthetic solution, which was 0.5 per cent Xylocaine with 1: 200,000 adrenaline. The disquieting feature of the disturbance is that the total amount injected into the vein must have been appreciably less than 10 ml. By contrast the author has on many occasions deliberately injected 10 ml. of 1 per cent procaine intravenously without the appearance of any untoward symptoms whatsoever. These experiences suggested that Xylocaine was probably the more toxic of the two drugs and it therefore seemed as if it might be worth while to carry out an experimental study of their relative toxicity.

A certain amount of work on this subject has already been done by Goldberg (1947, 1948 and 1949), by whom most of the original studies of the pharmacology of Xylocaine were made. His work suggested that on subcutaneous injection procaine and Xylocaine were of about equal

toxicity for mice in dilute solution at a concentration of 0.5 per cent, while 2 per cent solutions of Xylocaine were twice as toxic as those of procaine. In 0.5 per cent solution an $L.D._{50}$ of 1.07 g./kg. was obtained for Xylocaine and one of 1.02 g./kg. for procaine. The amount of fluid which must be injected subcutaneously to give a 20 g. mouse 1.02 g./kg. in $\frac{1}{2}$ per cent solution is just over 4 ml. or nearly one-fifth of the animal's total weight and four times its blood volume.

Toxicity studies in which such large amounts of fluid are given must be regarded as subject to a degree of error, since the administration of such a large amount of fluid will of itself give rise to profound modifications in the fluid balance of the animal. In fact it is possible that the animals may die simply of overdose of fluid rather than from any specific action of the drug itself. For these reasons it seemed that it might be desirable to repeat and to extend some of the previous work on the comparative toxicities of Xylocaine and procaine.

METHODS AND RESULTS

1. A direct determination of the toxicity of the two drugs on injection into the veins of white mice was carried out. The concentration of the solutions used was adjusted so that the volume injected was always less than 0.3 ml. and this was given slowly. By this study, the details of which are set out in Table I, it was established that the $L.D._{50}$

TABLE I

The toxicity of procaine and Xylocaine by the intravenous route in mice

Drug	Dose mg./kg.	No. of mice to whom it was given	No. of mice surviving
Procaine	50	6	5
	75	6	3
	90	6	0
Xylocaine	25	12	8
	37.5	6	0

for Xylocaine lay between 25 and 37.5 mg. per kg., while that for procaine was 75 mg. per kg. On this test Xylocaine seemed to be rather more than twice as toxic as procaine.

2. Since most local anæsthetic drugs are given by subcutaneous and intramuscular injection, it seemed that evaluation by injection into the subcutaneous tissues of animals would give a truer comparison. At first 2 per cent solutions of both drugs were used but it quickly became apparent that procaine is so lacking in poisonous action on mice that a 5 per cent solution would need to be used if the volume to be given were to be kept within the safe limit of 1 ml. The details of this study are set out in Table II. It

TABLE II
The toxicity of procaine and Xylocaine on subcutaneous injection

Drug	Dose mg./kg.	Strength of solution %	No. of mice to which it was given	No. of mice surviving
Procaine	150	2	3	3
	300	2	3	3
	600	2	3	3
	900	2	12	9
	1200	5	6	3
	1500	5	6	1
	1800	5	6	0
Xylocaine	900	2	6	0
	600	2	6	0
	450	2	6	0
	375	2	6	3
	300	2	6	6

will be seen that the $L.D._{50}$ of procaine was 1200 mg. per kg., while that of Xylocaine was 375 mg. per kg. Again Xylocaine had proved to be rather more than twice as toxic as procaine.

3. It has been generally agreed that the barbiturates protect against the lethal effects of overdose of local anæsthetic drugs of the benzoic acid ester type. Xylocaine is,

however, a derivative of acetanilide and it therefore seemed worth while to study the effect of barbiturates on the L.D.$_{50}$ of this drug. Phenobarbitone is the most effective anticonvulsant barbiturate in clinical use and for this reason it was employed first. In a dose which produced only mild drowsiness and ataxia in the animals it had no protective effect against the lethal effect of either procaine or Xylocaine. When, however, pentobarbitone was given in what was virtually an anæsthetic dose an increase of some 20 per cent in the L.D.$_{50}$ was observed (Table III). The

TABLE III

The action of various protective agents against procaine and Xylocaine poisoning in mice. The only significant protection demonstrable is that afforded by pentobarbitone

Drug	Route of administration	Dose mg./kg.	Protective agent	Dose mg./kg.	Mice used	Mice survived
Procaine	intravenous	90	none	—	6	0
Procaine	intravenous	90	phenobarbitone	90	5	1
Procaine	intravenous	90	pentobarbitone	30	6	3
Procaine	subcutaneous	1500	none	—	6	0
Procaine	subcutaneous	1500	phenobarbitone	90	6	0
Xylocaine	intravenous	37.5	none	—	6	0
Xylocaine	intravenous	37.5	pentobarbitone	30	6	3
Xylocaine	subcutaneous	450	none	—	6	0
Xylocaine	subcutaneous	450	phenobarbitone	90	6	0
Xylocaine	subcutaneous	600	none	—	6	0
Xylocaine	subcutaneous	600	adrenaline	1 : 200,000	6	0
Xylocaine	subcutaneous	450	none	—	6	0
Xylocaine	subcutaneous	450	adrenaline	1 : 200,000	6	0

addition of 1 : 200,000 adrenaline to solutions of procaine and Xylocaine did not reduce their toxicity to mice.

4. The results of the work so far performed seemed to indicate that Xylocaine was rather more than twice as toxic as procaine in mice. As has already been indicated, those who have used Xylocaine in the human subject, however, seemed to regard the two drugs as of about equal toxicity.

Comparisons in other species of animals than mice therefore seemed desirable. As a first stage in this work a series of assays of the relative toxicities of the two drugs were carried out on two anæsthetized cats by the method of Macdonald and Israels (1932). In these animals the amount of procaine required to stop respiration was about twice that of Xylocaine. Next a group of 5 rabbits received first procaine and 48 hours later Xylocaine by slow intravenous injection at a steady rate until convulsions developed. The administration was then discontinued and the animals allowed to recover, and in fact all of them did so after the administration of both drugs. It took nearly 4 times as much procaine as Xylocaine to produce convulsions on slow intravenous injection into rabbits (Table IV). Finally, the L.D.$_{50}$ for

TABLE IV

The convulsive doses of procaine and Xylocaine in rabbits

Weight of rabbit in grams	Dose of procaine to convulse mg./kg.	Dose of Xylocaine to convulse mg./kg.	Ratio dose of procaine : dose of Xylocaine
1750	21	5.4	3.8
3000	23	6.2	3.8
2000	25	6.0	4.2
2100	26	6.6	3.9
1550	21	6.1	3.5

both drugs was determined for a group of white rats all bred under the same conditions. Drugs were injected intravenously and the L.D.$_{50}$ for Xylocaine was found to be just under 25 mg. per kg., while that for procaine was just over 35 mg. per kg. (Table V).

TABLE V

The toxicity of procaine and Xylocaine given intravenously to rats

Drug	Dose mg./kg.	No. of rats to whom it was given	No. of rats surviving
Procaine	40	6	1
	35	6	4
Xylocaine	25	6	2
	20	6	6

DISCUSSION

The most obvious conclusion to be drawn from this investigation is that Xylocaine is a more toxic local anæsthetic drug than procaine in the four species of animals in which its action was tested. It will therefore probably be the more toxic of the two agents in man also. The ratio of the toxicities is somewhere in the region of 2: 1. If the long held maximum dose of procaine is to stand as it has done at 1.0 g. the corresponding figure for Xylocaine will be 0.5 g. Clinical experience has, however, already made it plain that the toxic dose of Xylocaine is usually considerably in excess of this amount. It therefore seems likely that the maximum safe dose of procaine appreciably exceeds 1.0 g. and in fact the experience of those who use this drug by slow intravenous drip methods bears this out.

There is, of course, no immediate way of discovering what really is the maximum safe dose of Xylocaine in man. It is possible only to continue to use the drug carefully in gradually increasing doses, bearing in mind that it probably is twice as toxic as procaine. Even if this does prove to be true, however, it will detract little from the clinical usefulness of the agent, which seems as if it is going to be effective in more dilute solution than procaine. Indeed, it has been the author's experience in a limited number of cases that 0.5 per cent Xylocaine with 1 : 200,000 adrenaline

is a local anæsthetic solution of equal potency with 1 per cent procaine and of very much longer duration. It is, moreover, a very much better vasoconstrictor.

The work done in this study has confirmed the observation of Knoefel and others (1930) that the barbiturates protect against local anæsthestic overdose and, as in that study the shorter acting drug amytal proved superior to the longer acting phenobarbitone, so in this pentobarbitone was better than phenobarbitone. The fact that pentobarbitone protects animals against the lethal effects of drugs of such different chemical structure as procaine and Xylocaine suggests that this protection is not mediated through any such process as competitive enzyme inhibition, but indicates rather that the barbiturate prevents the onset of some vicious cycle, which leads to the death of the animal. The vicious cycle which is not allowed to develop is that in which the local anæsthetic drug gives rise to convulsions, which first by their tonic, and later by their clonic contractions of the muscles of respiration cause anoxia. This anoxia is of itself epileptogenic and causes subsequent convulsions which produce more anoxia, and finally a brain which is incapable of any response, even that of a convulsion. When this stage has been reached, recovery is virtually impossible, since the first manifestation of spontaneous recovery is that convulsions again develop and restore the previous state of poisoning of the brain by oxygen lack. The animal under the influence of the barbiturate does not run the risk of this hazard, and in consequence the lethal dose is no longer that which will so upset the workings of the higher centres of the brain that convulsions develop, but the dose which will inhibit the normally more resistant respiratory centre.

SUMMARY

1. The toxicities of procaine and Xylocaine in mice, cats, rabbits and rats have been studied. Xylocaine is about twice as toxic as procaine.

2. It was found possible to demonstrate a protective action of pentobarbitone against the toxic effects of both procaine and Xylocaine in mice. Phenobarbitone gave no protection against either drug.

3. The addition of adrenaline to solutions of Xylocaine did not reduce their toxicity to mice.

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CAUDAL BLOCK WITH XYLOCAINE

By J. CLUTTON-BROCK

CAUDAL block with Xylocaine (w-diethylamino-2-6-dimethylacetanilide) has been used for a number of lower abdominal operations during the last few months, and whilst the number is far too small for any real assessment of its value, the results so far have been so remarkably successful that it was thought worth while to draw attention to this use of the drug in this preliminary communication.

The disadvantages of caudal block in the past have been, in the author's opinion, the uncertainty of the effect and the delay taken for the analgesia to come on. This, with procaine or amethocaine, was in the order of 20 minutes to half-an-hour. With 2 per cent Xylocaine the following order of times has been found to be usual, but there is considerable variation:

Perineal analgesia — 2 minutes after injection.
Analgesia to the umbilicus — 5 minutes after injection.

To begin with, some of the local analgesic solution was injected under the skin of the lower abdomen after the block was given in order that the surgeon might start the operation at once, but it was very soon found that unless the patient was turned over and prepared very rapidly, the injections were being made into an already analgesic area.

The following operations have been performed under caudal analgesia with Xylocaine:

Retropubic, intravesical and transurethral prostatectomy—17 cases.
Intravesical removal of papilloma of bladder—1 case.

Hysterotomy for severe toxæmia—1 case.
Cæsarean section—2 cases.
Fothergill's operation—1 case.
Combined synchronous abdomino-perineal excision of rectum, combined with very light general anæsthesia —3 cases.
Local excision of carcinoma of rectum, combined with very light general anæsthesia—3 cases.
Therapeutic and diagnostic (vascular diseases, white leg, sciatica, etc.)—10 cases.
For deliberate hypotension during ear, nose and throat operations—3 cases.

A caudal block has only been used where it seemed indicated, particularly for the very bad risk cases.

The disadvantages of spinal analgesia in the old and unfit are:

(1) The dangers and complications attendant upon the lumbar puncture.

(2) Motor blocking, which may extend to the muscles of respiration.

(3) The large drop in blood pressure which may attend even quite a low spinal block.

Sarnoff and Arrowood (1946) have pointed out that a much weaker solution of a local analgesic will block the sympathetic fibres than is necessary for sensory block, so that the sympathetic block with spinal analgesia goes to a much higher level than the sensory block owing to the diffusion of the drug in the cerebrospinal fluid.

Caudal analgesia to the xiphisternum has produced only a moderate drop in blood pressure, and even a severe drop in blood pressure produced by analgesia, almost to the clavicle in elderly subjects, has been found to be completely

controlled by small intravenous doses (e.g. 10 mg.) of Methedrine.

The motor block produced has never been more than partial and has never appeared to interfere with respiration.

What has impressed the writer most about this form of analgesia is the extremely good condition of the patient undergoing it. It has been used largely in prostatectomy in elderly, sometimes very elderly, and sick patients, and the improved condition of the patient has been remarked upon by the surgeon and ward sister. In one case, an old man of 85, who was prepared for combined synchronous abdomino-perineal excision of the rectum, was given 45 ml. of 2 per cent Xylocaine and the drop in blood pressure controlled with 10 mg. of Methedrine intravenously and 10 mg. intramuscularly. It was found that the growth was locally removable by diathermy excision through the rectum, and so the effect of the high analgesia by itself could be judged. There appeared to be no ill effects whatsoever.

The dosage used has been between 30 and 50 ml. of 2 per cent Xylocaine (plain) with a total of 0.25 to 0.5 ml. of 1 in 1,000 adrenaline added to the solution. There has been a great variation in the height to which the analgesia extends with any given dose and it is probable that larger doses of the drug have been used to begin with than are necessary, but the ill effects have been so slight that the margin of safety is obviously much greater than with spinal analgesia.

The only adverse effect that has been noted, apart from the fall in blood pressure, has been the slight vomiting attendant upon this fall; this has been controlled at once with Methedrine.

The technique of caudal block has been described often,

but the only point worth mentioning perhaps is that in the obese the sacrococcygeal ligament has had to be felt for with a needle, as the bony landmarks were quite impalpable. It was found possible to do this and satisfactory analgesia was produced.

A test dose of about 5–8 ml. of the solution has always been used to make sure that injection was not being made into the theca.

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THIOPENTONE IN ADDISON'S DISEASE

By JOHN W. DUNDEE

OPERATIONS are very rarely carried out in subjects with Addison's disease. The reason for this is well expressed by Rowntree and Snell (1931) viz. " If treatment necessitates any surgical procedure, the risk is prohibitive and should be assumed only after most serious consideration." It is easy to understand why anæsthesia for these subjects receives no mention in the literature. Lundy's (1942) choice of agent would be di-vinyl ether, but he does not mention having anæsthetized any cases. Simpson (1950a) recommends local analgesia for D.O.C.A. implants but does not give any reasons for his dislike of general anæsthesia in this condition.

Examination of particulars of 14 reported operations in subjects with Addison's disease (Rowntree and Snell, 1931; Katz and Mainzer, 1941; Leavitt, 1945; Simpson, 1950b) reveals that a severe crisis followed operation in 11 instances. With two exceptions the crisis proved fatal. Sufficient details are not available to incriminate the anæsthetic agent as a cause of the Addisonian crisis in any of these cases. The relationship between the anæsthetic agent and the Addisonian crisis is clear in the following case.

CASE REPORT

July 4, 1950. A woman, aged 45 years, weighing 9 stones (57 kg.) was admitted to hospital in Addisonian crisis. She was vomiting persistently, B.P. was 96/60, blood sugar 45 mg. per cent and blood urea 75 mg. per cent. Treatment with Eschatin, D.O.C.A. and intravenous drip of 5 per cent dextrose in normal

saline did not produce a satisfactory response and 48 hours after admission B.P. was 80/50. Failure of response to treatment was attributed to urinary infection and when this was eliminated her condition improved immensely.

August 9, 1950. Clinical improvement was sustained; B.P. given as premedication prior to D.O.C.A. implants, which it was 110/70; Hb 75 per cent; R.B.C.s 3.5 million per cu. mm.

August 14, 1950. B.P. 100/65. Morphia gr. $\frac{1}{6}$ (10 mg.) was intended to insert under local analgesia. Owing to a misunderstanding 0.4 g. thiopentone was administered. This was not followed by any undue respiratory depression, but the following sequence of events ensued:

5 minutes	B.P. 50/30, oxygen administered.
25 minutes	B.P. 50/30, implant carried out without any response from the patient.
1 hour	B.P. 60/30.
1¼ hours	B.P. 60/30, reacted to supraorbital pressure.
2¼ hours	B.P. 65/30, regained consciousness.
3 hours	B.P. 70/40, very drowsy, 5 ml. Eschatin intramuscularly.
6 hours	B.P. 70/50, still drowsy, 5 ml. Eschatin intramuscularly.
12 hours	B.P. 70/50, still drowsy, intravenous drip of 5 per cent dextrose in normal saline commenced.
18 hours	B.P. 85/50, one litre of infusion given, blood sugar 75 mg. per cent.

Mild crisis continued for further 24 hours, followed by complete recovery.

February 8, 1951. Further implants of D.O.C.A. carried out under 1 per cent procaine analgesia. There was an uneventful convalescence with no Addisonian crisis.

COMMENT

There seems little doubt that the rapid deterioration in the patient's condition was due to the thiopentone, as the collapse occurred before the operation commenced. This view is substantiated by the uneventful convalescence on the second occasion, when no thiopentone was given. The narcosis was prolonged, as the subject did not react when the skin was incised 25 minutes after 0.4 g. thiopentone, did not regain consciousness for 2¼ hours, and remained drowsy for a further 10 hours.

DISCUSSION

A fall in blood-pressure of the severity and duration recorded above is abnormal as, in the absence of operative shock or blood loss, blood-pressure returns to normal 10–15 minutes after the injection of thiopentone (Lockett, 1951). Blood-pressure in subjects with Addison's disease is very labile and possibly unduly sensitive to the action of depressant drugs. It has been noted that more extreme falls in blood-pressure are seen following the use of thiopentone in subjects already suffering from hypotension (Adams, 1944).

The rapid recovery that follows small doses of thiopentone is due to rapid diffusion of the drug to body tissues (Mark et al., 1949; Brooks et al., 1948) and fat (Mark et al., 1950). This diffusion would be interfered with by hypotension. In the crises of Addison's disease there is retention of potassium and excessive excretion of sodium chloride, causing dehydration of intracellular tissues. Extracellular dehydration would further interfere with diffusion of thiopentone. Both these factors would result in prolongation of thiopentone narcosis.

The adrenalectomized animal, or the patient with Addison's disease, manifests a tendency to hypoglycaemia, more marked under conditions of fasting or stress (Simpson, 1950b). A drop of blood-pressure to 50/30 must be considered sufficient stress to bring on hypoglycæmia. The blood sugar of this subject 18 hours after the thiopentone was 75 mg. per cent. Since one litre of 5 per cent dextrose (50 g. glucose) had been given immediately before this estimation, it is very likely that hypoglycæmia played a part in prolongation of the thiopentone narcosis. Coma in Addison's disease is most commonly due to hypoglycæmia.

The possibility exists that hypoglycæmic coma followed the thiopentone, giving the impression that the action of thiopentone was prolonged.

Prolonged hypotension, persistent vomiting and inadequate food intake could cause hepatic dysfunction (Davison et al., 1946) and increase the duration of thiopentone (Shideman et al., 1949). Flocculation tests, hippuric acid excretion and urinary urobilinogen in this subject were all within the limits of normality and preclude any severe liver dysfunction. Oliguria and raised blood urea are features of Addisonian crises, such as occurred following the thiopentone. Although blood urea was not estimated in this subject, it is unlikely that the urea could have risen to an extent capable of potentiating thiopentone (Richards, 1950) in the short time before the subject gained consciousness.

SUMMARY

The administration of thiopentone to a subject with Addison's disease was followed by severe hypotension and a crisis lasting for 48 hours. The various factors that could have played a part in this sequence of events are discussed. Hypotension, electrolyte imbalance and hypoglycæmia are most likely to have engendered in this subject sensitivity to thiopentone.

I am indebted to Dr. W. Sutton for permission to publish this case.

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Dr. Gillespie writes:

On 15th June, at a Convocation of the University of Wisconsin, the Honorary Degree of Doctor of Science was conferred on Dr. Ralph M. Waters. In presenting the candidate Professor Weaver recalled the *bon mot* of Dr. C. R. Bardeen, then Dean of the Medical School. When Dr. Waters first came to Wisconsin, Dr. Bardeen introduced him to the faculty with the remark that it was a unique distinction to have been appointed for his ability to put people to sleep. Dr. Waters soon showed, the speaker continued, that he was equally competent at waking people up! Professor Weaver then gave an epitome of Dr. Waters' work, quoting extensively from a biography which had appeared in this Journal. President E. B. Fred, in conferring the degree, said that he did so gratefully and with deep affection, "because your work has focused the attention of the world on this University."

OXYGEN DISSOCIATION CURVES OF WHOLE BLOOD IN THE PRESENCE OF ANÆSTHETIC GASES

By F. J. PRIME

THE hypothesis that anæsthetic gases might displace the oxyhæmoglobin dissociation curve of blood has been put forward by Halton (1948) in discussion of the actions of nitrous oxide. It is difficult to see how such a shift might be caused, but it was decided to put the matter beyond doubt by constructing a series of such curves in which blood was equilibrated with mixtures containing oxygen and carbon dioxide in appropriate proportions diluted with gaseous anæsthetics.

There are only two available mechanisms whereby the dissociation curve of oxyhæmoglobin might be affected by the addition of an anæsthetic. One is by altering the degree of aggregation of hæmoglobin molecules. In Hill's equation (Hill, 1910) for the oxyhæmoglobin dissociation curve a value is given to a constant n which is responsible for the inflections of the curve, and which signifies the extent of aggregation of the hæmoglobin molecule. Barcroft and his associates (1914) long ago determined the value of n at 1.5 under the normal range of physiological conditions. These workers also showed that at very high partial pressures of carbon dioxide and at the extreme ranges of pH the value of n was raised.

A second and more remote possibility would be the actual denaturation of hæmoglobin by anæsthetics such as ether and chloroform. Whilst these substances are highly active

as solvents, especially of fat, they are, in the main, chemically inactive. It is, therefore, somewhat unlikely that any specific changes would be brought about by their presence in blood, especially in the usual anæsthetic concentrations.

Any alteration in the oxygen dissociation curve is of obvious importance in connection with the survival of narcotised tissues. Oxygen passes from the arterial blood to tissue cells by virtue of a difference of oxygen pressure existing between them. The actual amount of oxygen carried by the blood is of secondary importance in this transfer, for any deficiency in this respect can, within certain limits, be offset by an increase in blood supply. For example, it has been established that in chronic anæmia of fairly severe degree, a general speeding up of the whole circulation occurs (Sharpey-Schafer, 1944); here arterial blood contains only a fraction of the amount of oxygen carried by normal arterial blood, even though it is fully saturated with oxygen at a partial pressure equivalent to the normal. The removal of even a small quantity of oxygen from such blood may, however, be sufficient to lower the pressure so far that diffusion into the tissues can no longer occur and the cells may suffer from anoxia. An increase in circulatory rate lessens this risk, by not allowing the blood to remain in contact with the tissues for a sufficient length of time to permit the escape of the usual quantity of oxygen from each unit of blood. There is good evidence (Prime and Gray, 1951) that the circulation of the anæsthetized patient may be greatly increased, and it is possible that this increase is related to the diminished utilization of oxygen which is known to accompany the state of anæsthesia. There is no incontrovertible evidence that this diminution in oxygen consumption is due only to a decrease

in the oxygen used by the protoplasm. It is conceivable that in addition to any such decrease in metabolic rate being the cause of a diminished rate of absorption of oxygen, there could also be an alteration in the physico-chemical properties of blood or, more properly, hæmoglobin, making it more difficult for the oxygen to pass from the blood into the tissues. Such an alteration would be reflected in a modification in the position or character of the oxygen dissociation curve of blood.

METHODS

(*a*) *Blood Samples*

The blood used in these experiments was taken from the vein of one subject. Oxyhæmoglobin dissociation curves were plotted carefully over a wide range of carbon dioxide tensions and were found to be constant in position when repeated at approximately ten-day intervals over a period of six weeks. (Fig. 1.)

(*b*) *Equilibration of Blood with Anæsthetic Gases*

During these determinations samples of the same blood were equilibrated with six gas mixtures containing varying quantities of oxygen, a suitable tension of carbon dioxide (20, 40 or 90 mm. mercury) and the anæsthetic gas under consideration. In the case of ether, nitrogen saturated with ether vapour was added to the oxygen and carbon dioxide to bring the mixture to atmospheric pressure.

Samples of these gases were taken into tonometers at atmospheric pressure and room temperature. The tonometers were cooled under the cold tap and, while still cool, fresh heparinized blood was introduced into them by immersing the outlet beneath the surface of the blood. The slight negative pressure induced in the tonometers by cool-

ing allowed one or two millilitres of blood to be drawn into them without admitting atmospheric air. The tonometers were then placed in a water bath held at 38° C., following the usage adopted by Sendroy, Dillon and van Slyke (1934), Barcroft (1914), and Bock, Dill and Henderson (1928), and rotated for five or six minutes. The gases inside the tonometers were then brought to atmospheric pressure by opening the taps briefly, thus allowing the escape of some of the gaseous contents. Rotation was then resumed for a further ten minutes, at the end of which time the taps were again momentarily opened. Finally, after another five minutes rotation, the tonometers were placed vertically in the water bath to await analysis of the blood and contained gases.

(*c*) *Method of Sampling*

The method of sampling was as follows. A dishcloth was held under the hot tap until its temperature was approximately 50° C. It was wrung out and a tonometer removed from the bath, keeping it vertical, and the dishcloth wrapped round it. As quickly as possible a receiver containing paraffin oil was placed below the end of the tonometer where the blood was held. The tap was opened and the increased pressure in the tonometer caused by the slight rise of temperature was sufficient to blow out all the contained blood, which gravitated into a mass below the oil. The cloth was then removed from the tonometer, which was connected to the gas analyser for determination of carbon dioxide and oxygen.

(*d*) *Gas Analysis*

In the case of samples containing ether this gas was absorbed first and the carbon dioxide and oxygen determined in that order by the technique described previously

(Prime, 1950). For cyclopropane the same procedure was followed. In the case of nitrous oxide, however, carbon dioxide was absorbed first and then oxygen. In all these cases it was not necessary to know the percentage of anæsthetic gases present in the mixtures but only the carbon dioxide and oxygen. All gas analyses were repeated in triplicate.

(e) Determination of Oxygen Capacity and Blood Oxygen Content

In addition to the tonometer samples of blood, a seventh portion was equilibrated with room air in order to determine its oxygen capacity. Figures for percentage saturation were then calculated for the tonometer samples from their oxygen content and that of this seventh sample. The blood oxygen was determined by a modification of Exton's colorimetric method. This consists of calibrating the colorimetric method directly against the manometric one of van Slyke and Neill (1924) in order to reduce a systematic error which exists if Exton's original method is used (Prime, 1951). With this modification, the colorimetric method was found to be reliable by comparison of results obtained by it with those obtained by the manometric method, and it has been found that the oxygen content of blood can be estimated to within ± 0.7 volumes per cent. In the case of etherized samples the blood oxygen was always determined by this method; that of the other samples was determined either by this method or by that of van Slyke, modified by Orcutt and Waters (1937).

RESULTS

From these analytical results, four sets of three curves were drawn for the control mixture and each of the three anæsthetics used. (Figs. 1, 2, 3 and 4.) Each curve

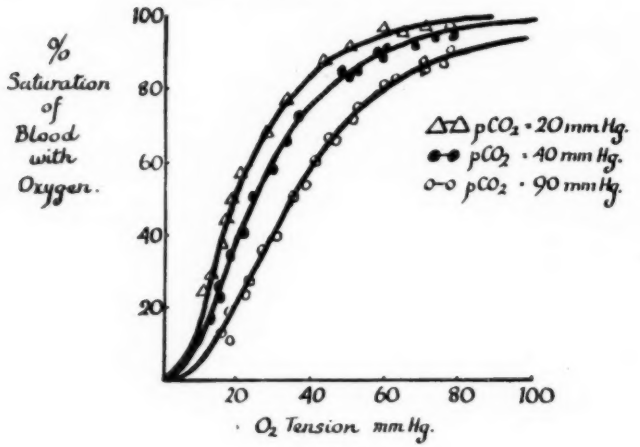

FIG. 1
O_2-dissociation curves of whole blood equilibrated with oxygen and nitrogen in the presence of fixed amounts of CO_2

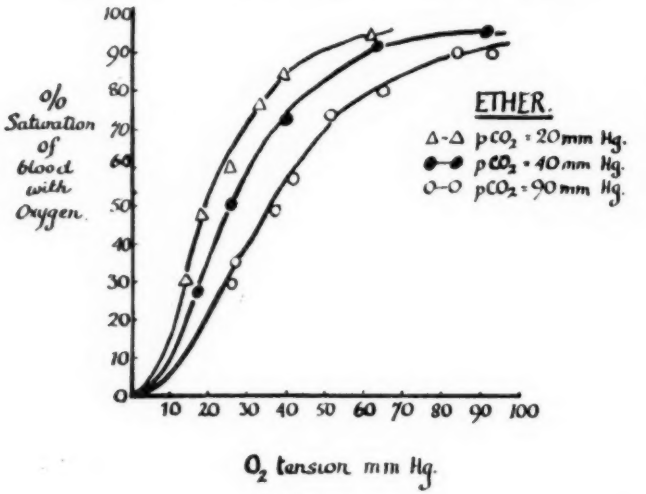

FIG. 2
O_2-dissociation curves of whole blood equilibrated with oxygen and nitrogen saturated with ether vapour in the presence of fixed amounts of CO_2

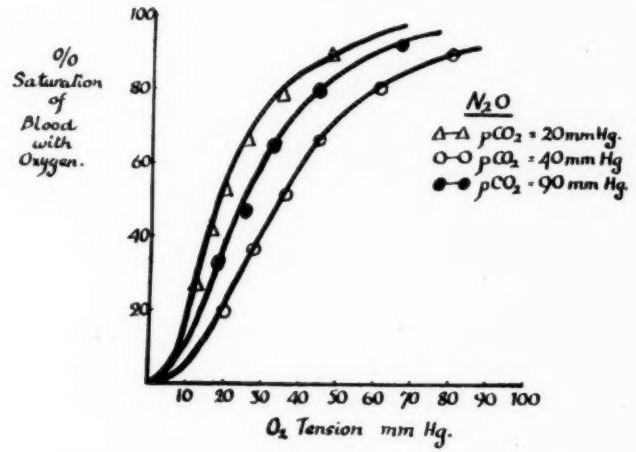

FIG. 3
O_2-dissociation curves of whole blood equilibrated with oxygen and nitrous oxide in the presence of fixed amounts of CO_2

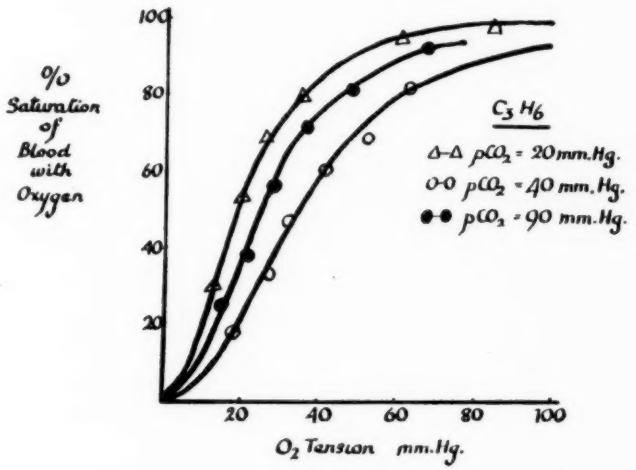

FIG. 4
O_2-dissociation curves of whole blood equilibrated with oxygen and cyclopropane in the presence of fixed amounts of CO_2

represents the mean of four determinations.* In plotting the curves it is necessary to smooth the data in order to allow for slight alterations in pCO_2 which occur as a result of the transfer of this gas during equilibration. This correction is made by linear interpolation from the standard curves published by Barcroft (1914). Alternatively, the correction may be calculated by a formula given by Henderson (1928); the use of the formula is, however, cumbersome and unnecessary.

Figure 1 represents the curves for the blood of the subject of these experiments when anæsthetics were not present in the equilibrating gases, and figures 2, 3 and 4 are those obtained when anæsthetics were present. No shift is apparent in the positions of these curves in comparison with the first, though it is fair to point out that minute shifts could occur which it was beyond the accuracy of the methods used to detect. Even the standard curves are open to criticism in this respect. Barcroft allows an error of about 5 per cent of saturation in his own determinations. In his case the blood gases were determined by means of the Barcroft manometer, which is a very delicate method of assay. The colorimetric method used in this investigation has a much greater error, but in no case is the error so great as to be of considerable importance physiologically. It may be concluded, therefore, that anæsthetic gases *per se* have no appreciable influence on the positions of the oxygen dissociation curve of blood.

* The data for figure 1 are compiled from results of eight separate experiments performed to fix the position of each curve, three for the lower curves and two for the uppermost. In figures 2 to 4 each point is the mean of results obtained by replicate analyses of both blood and gas phases on at least two separate occasions.

SUMMARY

1. The possibility of an alteration in the oxygen dissociation curve of blood in the presence of gaseous anæsthetics is discussed, and attention drawn to its possible significance.

2. The method of investigating these dissociation curves in the presence of ether, cyclopropane and nitrous oxide is described and the results at three different partial pressures of carbon dioxide detailed.

3. It is demonstrated that no significant shift in the oxygen dissociation curve occurs.

I am greatly indebted to Miss D. M. Sowter for her assistance in the conduct of these experiments. Many of the analyses required were undertaken by her with a care and reliability beyond criticism.

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THE EFFECT OF INTRACISTERNAL INJECTION OF ISOTONIC SODIUM CHLORIDE SOLUTION ON THE EAR REFLEX OF THE DOG

By T. H. B. BEDFORD

EVIDENCE has been provided (Bedford, 1946, 1948a, 1948b, 1949) that the injection of isotonic sodium chloride solution (0.9 per cent w/v) into the cisterna magna of the dog is followed by a cellular reaction indicated by the presence of polymorphonuclear leucocytes in the cerebrospinal fluid, and by a rise in the pressure of the cerebrospinal fluid. The injection of distilled water under similar conditions causes only a slight cellular reaction and the pressure of the cerebrospinal fluid is not raised. Moreover, convulsions are more easily excited by intracisternal injection of crystalline penicillin dissolved in isotonic sodium chloride solution than by injection of the drug in distilled water. In view of the evidence of irritation of the nervous system provided by the results of these experiments, it was decided to investigate the effect of intracisternal injection of isotonic sodium chloride solution on a nervous reflex. The effect on the ear reflex of the dog has been studied in the following experiments.

EXPERIMENTAL PROCEDURE

The animals were anæsthetised with intravenous pentobarbitone ("Nembutal" (Abbott)) and maintained in a state of light anæsthesia by the administration of additional pentobarbitone when required. Reference should be made

to earlier papers for details of general experimental technique. The duration of the experiment was six hours.

The ear reflex was elicited by stroking the hairs of the ear with a mounted gauge 18 needle stilette. The reflex is most easily excited by stimulation of the hairs of the internal aspect of the ear. It is usually obtained only after stimulation directly over the ear but in conditions of irritation of the nervous system it can be elicited by stimulation over the whole of the area supplied by the fifth nerve and mere breathing on the face may be sufficient to excite it. Even under these circumstances, stimulation of other parts of the body failed to produce the reflex and it was noticed that a sudden loud noise was incapable of doing so. A standard method of stimulation was employed throughout the experiments. The end of the stilette was first gently trailed over the hairs of the external aspect of the ear so as to deflect them but without actually touching the skin. The area stimulated was as far as possible the same in all experiments. When three strokes of the stilette had failed to excite the reflex, the internal aspect of the ear was treated in a similar manner. A period, not less than five minutes in duration, was allowed before repeating the stimulation even when unsuccessful.

RESULTS

The effect of pentobarbitone anæsthesia on the ear reflex.

The effect of pentobarbitone anæsthesia was studied in twelve dogs. Intravenous pentobarbitone to the level of surgical anæsthesia caused an immediate disappearance of the reflex which remained absent as long as anæsthesia was maintained. As light a degree of anæsthesia as was compatible with the conduct of the experiments was therefore

employed and the knee reflex invariably remained brisk. In a number of experiments the effect of partial recovery from the anæsthetic was studied. Here again the ear reflex was unobtainable up to and including the stage of spontaneous movements.

The effect of intracisternal injection of distilled water on the ear reflex.

Distilled water was introduced into the cisterna magna of eight dogs. In one half of the experiment 1.0 ml., and in the other half 2.0 ml. of distilled water were injected. The ear reflex remained absent throughout the course of the experiments.

The effect of intracisternal injection of 0.9 *per cent sodium chloride solution on the ear reflex.*

This was studied in ten dogs. In four of the animals 1.0 ml., and in the remaining six 2.0 ml. were introduced The ear reflex was obtained in one of four experiments after the injection of 1.0 ml. solution. It was elicited, however, in four of six experiments in which 2.0 ml. solution had been introduced. The time of appearance of the reflex after intracisternal injection varied from 2 hours to 4 hours but the average time was $2\frac{1}{2}$ hours.

The reflex was often obtained on stimulation of one ear only and it was occasionally restricted to one aspect of an ear throughout an experiment. It was only obtained when the animal was lightly anæsthetised and was temporarily extinguished by the administration of additional anæsthetic, returning again after the depth of anæsthesia had been reduced. There was no evidence that the reflex when once established changed its character or disappeared spon-

taneously during the course (6 hours) of the experiments, provided a suitable degree of anæsthesia was maintained. The knee reflex persisted throughout the experiments. The results of the experiments are summarised in Table I.

TABLE I

The effect of intracisternal injection of 0.9 per cent NaCl solution on the ear reflex of dogs under pentobarbitone anæsthesia

Dog No.	Weight in kg.	Total of pento-barbitone adminis-tered in g.	Volume of solu-tion intro-duced in ml.	Time of appearance of ear reflex after introduction of solution in min. Rt. Ear Ext.	Rt. Ear Int.	Lft. Ear Ext.	Lft. Ear Int.
1.	7.4	0.575	1.0	—	—	—	—
2.	11.0	1.040	1.0	—	—	—	—
3.	7.1	0.505	1.0	135	135	—	150
4.	7.4	0.645	1.0	—	—	—	—
5.	7.5	0.500	2.0	—	—	—	—
6.	9.9	0.750	2.0	—	—	240	—
7.	6.6	0.370	2.0	—	120	—	—
8.	9.0	0.600	2.0	165	165	180	165
9.	9.2	0.680	2.0	120	120	—	—
10.	7.2	0.400	2.0	—	—	—	—

DISCUSSION

It will be seen from the above experiments that the introduction of 0.9 per cent sodium chloride solution into the cisterna magna of the dog caused the reappearance of the ear reflex abolished by pentobarbitone anæsthesia in one experiment out of four after 1.0 ml. solution had been introduced and in four experiments out of six after the introduction of 2.0 ml. solution. The introduction of distilled water invariably failed to restore the reflex.

These results are to be anticipated, from the findings of earlier experiments (Bedford 1948a, 1948b) in which the

injection of 0.9 per cent sodium chloride solution into the cisterna magna provoked a marked cellular reaction and a rise in the pressure of the cerebrospinal fluid. Distilled water on the other hand was found to cause only a mild cellular reaction and no rise in the pressure of the cerebrospinal fluid. It is not therefore surprising that some modification, especially of cranial reflexes, should be discovered after intracisternal injection of isotonic sodium chloride solution. No evidence is provided by these experiments regarding the precise site of action of the sodium chloride solution. In view of the marked irritation of the meninges demonstrated in earlier experiments, it would seem justifiable to conclude that the nerve roots are probably involved along with the meninges. No change was observed in the knee reflexes.

The injected solution, however, would exert its main action in the nerve roots in the immediate vicinity of the mid-brain and medulla and if any sodium chloride solution actually reached the lumbar region of the cord, it would by that time be considerably diluted. It must be admitted, however, that the experimental technique employed in these experiments was incapable of detecting minor changes in the character of the knee reflexes. There was no evidence that the ear reflex when once restored disappeared during the course of an experiment. This finding conforms with those of earlier experiments (Bedford, 1948a, 1948b, 1949) in which the irritant action of 0.9 per cent sodium chloride solution, unlike that of penicillin or of distilled water, was found to be prolonged.

These experiments provide additional evidence for caution in the use of sodium chloride in adjusting the osmotic pressure of solutions required for introduction into the subarachnoid space.

SUMMARY

A study has been made of the effect of intracisternal injection of 0.9 per cent sodium chloride solution on the ear reflex of dogs anæsthetised with intravenous pentobarbitone. Control experiments established that the reflex is unobtainable in dogs under pentobarbitone anæsthesia. The ear reflex reappeared in one of four experiments after the intracisternal injection of 1.0 ml. sodium chloride solution and in four of six experiments after the injection of 2.0 ml. solution. The injection of distilled water in corresponding volumes was without effect. It is concluded that the experiments provide additional evidence for caution in the use of sodium chloride in adjusting the osmotic pressure of solutions required for introduction into the subarachnoid space.

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EMINENT ANÆSTHETISTS, No. 6

WESLEY BOURNE

By HAROLD R. GRIFFITH

I WELCOME the opportunity to write about one of the great anæsthetists. I do not wish my words to sound just like a eulogy—and much less an epitaph or an elegy—but I cannot claim to be entirely dispassionate because the subject of these biographical notes is not only my mentor, my teacher and my academic predecessor; he is also my closest and dearest friend.

Wesley Bourne was born in Barbados, British West Indies, on April 24, 1886, the son of James Thomas Bourne and Mary Elizabeth Harding (all good old English names.) He and his three brothers and one sister grew up in the pleasant, devout and cultured atmosphere of a tropical plantation home. Wesley learned to love the sea, the green fields, the trees and flowers, and the open sky. The whole of his formal education before coming to medical school was obtained at the little "Lodge School" in Barbados. Here he came under the influence of teachers who were all Oxonian scholars; and who, with the assistance of two very salutary canings, instilled into Wesley a deep love for the classics. Fortunately for the literature of anæsthesia, his mind has remained impregnated with much that he learned as a boy.

In 1907 Wesley Bourne came via New York to Montreal, saw his first maple leaves and snow, and other Canadian wonders; and plunged immediately into the study of medicine at McGill University. Shepherd, Mills, Adami, Armstrong, Lafleur, Chipman, Martin, Blackadar, were

among McGill teachers of that day who had succeeded to the mantle of the great Osler. Young Bourne's college career was uneventful except for a long bout with mumps, and the winning of first place in Anatomy. He graduated in 1911, as Doctor of Medicine and Master of Surgery, spent the next year attending to the medical needs of a railway construction gang in Western Canada; and then returned to the Royal Victoria Hospital in Montreal to learn to be a surgeon. He was the bright protegé of Edward Archibald, who later became McGill's cultured, wise and much beloved Professor and achieved world renown as the " father " of thoracic surgery. To Archibald, whose warm friendship was always an inspiring and steadying influence, Bourne attributes much of his professional success. Anæthesia at the Royal Victoria Hospital was at that time administered single handed by Dr. F. W. Nagle, one of the very few Canadian specialists in this field. He needed help, and Archibald asked young Bourne to try his hand at " dropping ether ". Thus the die was cast—from that day on, surgery was superseded by the gradually developing and all-engrossing realm of anæsthesia. When, a few years later, Nagle met a tragic death, Bourne was offered his post. But the idea of a full-time hospital appointment did not appeal to the rising young anæsthetist, and he wisely chose to remain in private practice.

Bourne's connection with the teaching staff of McGill University dates from 1921, when he was appointed Lecturer in Pharmacology, a position which he occupied for nearly twenty-five years until the Department of Anæsthesia was established. Thus he began the research and the scientific writing which have made his name known throughout the world. He somehow found time to combine this activity with his busy, prosperous clinical practice; and to

travel to countless professional meetings and conferences throughout North America, Great Britain and other parts of the world.

In 1913 Wesley Bourne had the good fortune to marry lovely Sara McGillis of Montreal. Their happy home throughout the years has been blessed by the arrival of three sons and one daughter, and now several grandchildren. Douglas, the eldest, served as a major with the Royal Canadian Corps of Signals in Iceland, and is now an electrical engineer in Montreal. John, the second son, became at twenty-five a Lieutenant-Colonel in the First Special Service Force, that super-commando American-Canadian combined regiment which was the brainchild of Winston Churchill, and which was used for specially hazardous ventures. John Bourne commanded the first tank which clattered into the streets of Rome, after the bitter fighting of Anzio. Robert, the youngest, graduated in medicine at McGill in 1949, and is preparing himself for a career in internal medicine. Barbara, the only daughter, is to be married this autumn, and so Wesley and Sara will be alone at home—but with what happy memories, and with their children and grandchildren still near by.

Wesley Bourne's contributions to anæsthesia have been in the four fields of clinical practice, laboratory research, writing and teaching. So outstanding has been his eminence in each field that it is quite impossible to pick out any one achievement as his greatest. In clinical anæsthesia he is a master of the art, with an almost hypnotic approach to his patients. He loves people; he is interested in their problems; he sees things from their point of view; and he inspires confidence. He has been a pioneer, although never quite the first, in the clinical use of almost all the new agents which have been introduced into anæsthesia in the last

generation. He is alert to what others are doing, he has good judgment in sorting the good things from the impractical ones, and he is a critical observer. In his clinical work he has been successful because he knows that fear, anxiety, apprehension, may be just as harmful to the patient as physical blows or chemical poisons. Much of his work towards the popularization of new agents and new methods has been prompted by the need to make anæsthesia and recovery less distressing and more comfortable. In this regard I am reminded of Dr. Bourne's love for unusual words (which he always uses properly)—he tells our students that the purpose of pre-operative medication is " to obtund, to obfuscate, and to obnubilate! "

On appointment to the teaching staff at McGill, Wesley Bourne plunged at once into the laboratory investigation of anæsthetics and of the effect of anæsthetic drugs upon human physiology. His first paper was on " The Anæsthetic Properties of Pure Ether ", and then there was a rapid succession of studies on acidosis, on the excretion of phosphoric acid, on heat regulation, and on water exchange. In collaboration with Barbour, Stehle, Raginsky, Melville and other pharmacologists he published reports on liver and kidney function which have become classics in the literature of anæsthesia. Much of his laboratory work was done at night because his days were filled with clinical practice, and all of his reports are written in precise and faultless style. In 1924 he was awarded the Master of Science degree by McGill University, and in 1935 he became the first Hickman Medallist of the Royal Society of Medicine. As each new anæsthetic agent came into use, it was subjected to the critical analysis of Bourne's laboratory study, and we have from his pen many reports about Avertin, vinyl ether, cyclopropane, Amytal, Pentothal, Nupercaine and Pitressin. The

total number of his contributions to medical literature is now more than one hundred articles. As the years went by he allowed his writing to become not less scientific but more philosophical, and he gave rein to his erudition and his love for the classics. This is reflected in the titles of some of his more recent contributions, for example—" De Officiis in Anæsthesia ", " The Perfecting of Anæsthesia ", " Anæsthesia for the Republic of Plato ", " Wise Indifference of the Wise in Anæsthesia ", " On Learning Anæsthesia ", " At the Head of the Table ", " Anæsthesia, Pursuit of Learning ", " Fors Clavigera in Anæsthesia ", and " Measure and Order in a School of Anæsthesia ". The following quotations, limited as they must be, will give some impression of his style, his breadth of interest, and his rich form of expression.

" It seems not too much to assume that customarily not nearly enough attention is paid to fear, which is perhaps the most fundamental of animal emotions. Anyone contemplating a surgical operation is subject to some degree of fear . . . out of it may come excruciating phantasmagoria during the period of going under an anæsthetic, and such spectres are so realistic that severe shock may ensue, the end-result of which nobody can foretell. Suffice it to say that tremendous dissipation of nervous energy is very likely to occur. It is our duty, therefore, to allay fear. . . . The physician should adopt metaphysical (in the broader sense) principles, apply them himself, and solicit the co-operation of all attending the patient . . . these principles, in general, belong to the cultivation of a psychological approach as well as to the carrying out of some psychological ritual through the affectation of voice and gesture, gentle and persuasive, in order to inspire confidence, gain reliance, and induce harmonious contentment."

" From a consideration of the effects of anæsthetics on the liver, two aphorisms may be engendered, namely, that chloroform is to be eschewed, and that oxygen should be used with all general anæsthetics. . . . We do well to remember that oxygen is virtually a food; indeed in anæsthesia it might be considered an ambrosial food."

"In olden times the liver was thought to be the seat of love or lust and in this manner the father of Euphuism, the Oxonian, John Lyly, of Elizabethan days, made mention of it in his *Endymion* as: 'It tickleth not my liver!' Whether or no it be true that such passion saps vitality, we must now behold the liver with other than amatory eye. The liver is a prodigious organ, possessed of multiform activities, assimilatory and secretory, diurnal and rhythmical. However, despite its magnitude and physiologic importance, its cells are exceedingly susceptible to injury, so that in the very performance of their duties they are apt easily to succumb."

"The perfect anæsthetic is far to seek, and, vague-looming, may remain in the realm of the ideal. It is difficult to conceive of a chemical entity capable of producing narcosis without untoward action and at the same time suitable for all manner and conditions of men. Rather is it better to believe that our end and aim in ease will be attained the sooner by using such anæsthetics as are least harmful, by improving the methods of their administration, and by being prepared to offset or lessen deleterious effects."

"It stands to reason that he who learns from many masters, all else being equal, will these outdo, as time goes on, in knowledge and action. It stands to reason that he will be more capable, more Jeffersonian, more perspicacious than he who abides too long with one set of categories. . . . Let us avoid becoming too fond of any one idea or thing, any one drug or method, even be it method of teaching. Let us, rather . . . do all in our power to bring it about that the anæsthetist of to-morrow will be more accomplished than are we. Shall we not thus be attempting the altruistic?"

Throughout his whole professional life Wesley Bourne has been active in the group activities of anæsthetists. Stimulated by Frank McMechan in 1920, he became the organizer and secretary of the original Canadian Society of Anæsthetists, which was ten years later merged with the Canadian Medical Association. He designed the crest of the Society, which shows the Greek God Hypnos pouring from his horn the poppy juice, and he chose the motto which I think is still the best description of the anæsthetist's duty, *Καθευδοντας παρατηρουμεν*, "We watch closely those who sleep." In 1932 he was Vice-President of the Section of

Anæsthesia of the British Medical Association. He served as President of the International Anesthesia Research Society in 1925, and again in 1940. He was Chairman of the Section of Anæsthesia of the Canadian Medical Association from 1932 to 1936, and in 1942 he was elected President of the American Society of Anesthesiologists—the only foreigner to be so honoured. He represented Canada and the United States at the Anæsthesia Centenary celebrations in England in 1946, and was an official delegate to the First Latin-American Congress of Anesthesiology at Buenos Aires in 1949. In 1950 the Congress of Anesthetists at Miami, Florida, was held in honour of Wesley Bourne, and on that occasion the anæsthetists of the Province of Quebec presented to him his portrait painted by A. Sherriff Scott, R.C.A., which is reproduced as the frontispiece of this journal. This gesture which was fostered by his French-speaking colleagues was particularly touching to Dr. Bourne, because the promotion of good relations between the two language groups in Quebec has long been one of his fondest aims.

As a teacher, Wesley Bourne has stimulated and inspired countless young anæsthetists. However, post-graduate teaching was informal and unorganized until 1941 when he and Digby Leigh, and some others in the Montreal group, offered their services to the armed forces for the systematic training of medical officers to be anæsthetists. A four months' course was organized, and from that time until the end of the war a succession of doctors from all three services were given intensive teaching in both the clinical and basic science aspects of anæsthesiology. Dr. Bourne became Consultant to the Royal Canadian Army Medical Corps with the rank of Lieutenant-Colonel, Dr. Leigh was Consultant for the Royal Canadian Navy, and I for the Royal

Canadian Air Force. The whole programme was designed and directed by Dr. Bourne as a patriotic duty, and without any personal remuneration. In 1945 the pattern of this course was followed in the organization of the Department of Anæsthesia of McGill University. The Principal and Governors of the University decided to establish anæsthesia as an independent Department in the Faculty of Medicine, and Wesley Bourne was appointed the first Professor. With characteristic energy he proceeded to organize systematic teaching in anæsthesia for graduates as well as undergraduates. A three-year Diploma Course for specialist training was started, with the unique advantage that students rotate as residents every six months between various co-operating hospitals, and come together frequently and regularly for seminar discussions, basic science courses and other lectures. The curriculum of the Department was so wisely planned that it has continued almost unchanged in spite of inevitable changes among teachers, and wide variations in the numbers and qualifications of the students. The " Monday evening forums " of this group have become famous, attracting French and English-speaking anæsthetists, and visitors in large numbers. Although Dr. Bourne has delegated the active direction of these colloquia to others, no "Monday evening " is ever complete without his friendly, stimulating presence.

The Chairmanship of the McGill Department of Anæsthesia has now, through the inevitable passage of the years, been passed on to other hands. However, if nothing else remained of all the work of Wesley Bourne for anæsthesia, this Diploma Course alone would be a worthy and lasting memorial. Already, dozens of its graduates have gone to many places throughout the world to assume leading positions in hospitals, in practice, and in other medical

schools. Each one has left McGill with the words of his great teacher ringing in his ears: " Although it is not given to us to know the whole truth, we do know that the secret of all learning lies in the passion for the search, and we shall do well to remember the warning of Horace, ' Life grants no boon to man without much toil . . .' The anæsthetists of tomorrow, having fulfilled these requirements, should become inured with the spirit of rational effort, with a zeal for measuring; should become imbued with an urge for inquiry, governed by sense of order."

Wesley Bourne has been more than just an able teacher, a brilliant scientist and a good clinician. His greatest contribution to our profession and to the specialty of Anæsthesiology is the flame of passionate idealism which has illuminated his own life, and with which he has ignited in his students a spirit of devotion to duty, to truth, and to the welfare of humanity. He claims that he is not a " religious " man, but actually he is full of a deep faith in God, and his mind is brimming over with the richest fruits of the great essayists, poets and philosophers. He has inspired many young men to " preach the Gospel "—not only the gospel of better anæsthesia, but the gospel of better Christian citizenship. On May 21, 1950, Dr. Bourne preached a sermon entitled " Cultivate your Gardens " in Christ Church Cathedral in Montreal on the occasion of " Hospital Sunday ". I wish that all the wise and good things he said at that time might be recorded here in just the inimitable way in which they were delivered. I shall have to content myself with the following quotations:

> " Despite the beneficient inroads of science, art will little wane nor long lag in medicine. This is not art for art's sake, nor art for relaxation, it is rather art as technique implying purpose with the ideal of such perfect adequacy that ' art conceals art. . . .'

Let us call medicine an art and a science. Let us call it both or neither. . . . Edwin Grant Conklin has written: 'The ethic of the great scientists is essentially similar to that taught by great religious leaders. . . . The Decalogue of Moses might be accepted as the Decalogue of Science if the word "Truth" were substituted for the word "God". . . .' As scientists we are inheritors of a noble ethical tradition: we are the successors of men who loved truth and justice and their fellowmen more than fame or fortune or life itself. . . . 'To us the inestimable privilege is given to add to the store of knowledge, to seek truth not only for truth's sake but for humanity's sake, and to have a part in the greatest work of all time, namely—the further progress of the human race through the advancement of both science and ethics . . .' In this mood I could go on to quote many more excellent authorities. But I must forbid myself the pleasure. Only, let us realize that art and science are not disparate. Let us understand that the science of morals, namely ethics, and science, whether natural or physical, belong to one another. Indeed, they are at their best when thought of together. . . . Utterly to interfuse one with another seems as natural as the essential unity of hue and form and odour of a blossom. . . . Let us remember the three sister words of love—*philosophia, philanthropia, philotechnia.* The Father of Medicine, Hippocrates, used these words together. . . . In a delightful little book called *The Two Villages*, Lord Elton writes that 'there can in fact be no collectively good people unless there be many separate good men.' Then he goes on: '*Cultivez votre jardin*—for the average citizen there could hardly be more salutary advice. Cultivate your gardens! A great many tidy and fertile plots make a prosperous country. Cultivate your gardens!' Let us cultivate the garden of youth, so to tend the coming generations.

"The idea of 'Hospital Sunday' . . . arouses devotion to human interests, and lends fervour as it reminds us that Jesus said, 'Ye have the poor with you always, and whensoever ye will ye may do them good.' And again, 'Inasmuch as ye have done it unto one of the least of these my brethren, ye have done it unto me.'"

This, then, is the measure of the stature of Wesley Bourne.

NOTES AND COMMENTS

A MODIFIED WATER'S AIRWAY

The Water's airway has the great disadvantage that it is not easy to clean inside and it is quite impossible to tell by looking at it whether it is clean.

I have modified the Water's airway by removing most of one side (fig. 1). This in no way alters its property as an airway but it is easily cleanable with the usual test tube brush and all the parts of the inside are easily seen.

The contents of the airway that was altered were something of a shock!

J. CLUTTON-BROCK
Lincoln

CORRESPONDENCE

ROTAMETERS IN ANAESTHESIA

Sir,

The assessment of priority claims is doubtless a nuisance to historians and it is perhaps unfortunate that the correspondence on Rotameters referred to by Dr. Bryce Smith in the April 1951 (p. 124) issue of the *British Journal of Anæsthesia* was closed by the Editor of the *Lancet* before all the facts were revealed. I therefore welcome an opportunity to clarify my association with any controversy which may have arisen over this matter.

On April 13th, 1932, I was privileged to visit the works of the British Oxygen Company at Wembley. I was accompanied on the tour by the Manager, Mr. H. B. Parrott, Mr. H. A. Chapman, in charge of the Medical Section, and Dr. C. R. Hausman, Scientific Adviser, any of whom can vouch for my enthusiasm when I first saw a Rotameter in action on the oxygen plant. I was at once impressed by the superiority of the metal bobbin in the Rotameter over

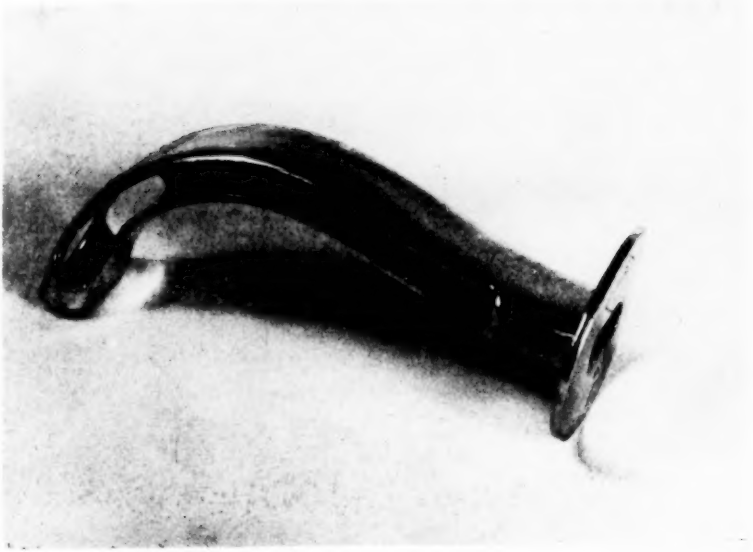

FIG. 1
Modified Water's Airway

the type supplied with the Siebe Gorman flowmeter which I had been using for a number of years. On the same day I requested Mr. H. A. E. Talley, who was then in the service of Messrs. A. C. King, to approach the Rotameter company forthwith with a view to obtaining Rotameters for anæsthetic apparatus. An affirmative reply was received to the effect that Rotameters were made in Germany, delivery would take six months, and the cost would be £4 10*s*. 0*d*. per meter. These factors deterred me from further action at that time. It is a reasonable contention, however, that the suggestion that Rotameters be used for anæsthetic purposes was put forward by me in April 1932.

Later, when cyclopropane came into use, it was clear that accurate readings at low flow rates were essential for this gas, and particularly for oxygen in the necessary closed technique.

I decided that the Rotameter would fulfil this purpose, and although Mr. Trost may have no record of it, I have the evidence of Mr. H. A. E. Talley that the first three Rotameters ordered by Messrs. A. C. King were made to my specification to fit an apparatus of my own design. I am unable to give the exact date of this order as my records and those of Messrs. A. C. King were destroyed by enemy action. It may have been later than 1935, but I am convinced that it was before 1937.

I need hardly add that the priority claim advanced on behalf of Mr. Richard Salt (*Lancet*, December 6th, 1941, p. 718) was my first intimation of his interest in the subject.

Yours faithfully,

I. W. MAGILL
London

ADAPTATION OF AYRE'S T PIECE TO A SMALL MASK

Sir,

In the January 1950 edition of your journal which just arrived here Dr. J. G. Rees describes a device for reducing dead space which is an adaptation of Ayre's T piece to a small mask. I would like to state that since 1944 I have been using a similar device which was published in the *Revista Argentina de Anestesia y Analgesia* of January 1945, and presented before the Asociación Argentina de Anestesiología on November 18, 1946. As you can see by the enclosed illustrations my device is essentially based on the same principle as that of Dr. Rees (figs. 2 and 3).

Yours faithfully,

FRANCISCO J. NESI
Buenos Aires

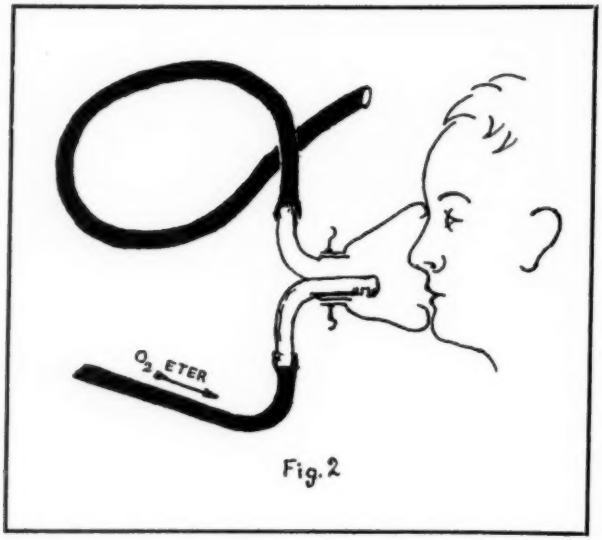

Fig. 2

POST-ANAESTHETIC GRANULOMA OF LARYNX

Sir,

Having read the article by Drs. Moulden and Wynne dealing with post-anæsthetic granuloma of the larynx (*Brit. J. Anæsth.*, **23**, cf.), may I enter a plea for the use of " Portex " plastic endotracheal tubes.

The authors draw attention to the possibility that the spring-like pressure of a deformed (rubber) curved tube in operations involving an extended neck may be a factor in the causation of granulomata.

" Portex " plastic tubes, at body temperature, readily mould themselves to the curvatures of the respiratory passages, and do not therefore exert that spring-like pressure to which they refer, even in extreme positions of the head and neck. Unlike rubber endotracheal tubes, plastic tubes stand up well to use, their consistency being little altered by years of boiling. I am still using a tube which was originally bought in 1945.

I should like to see a more general use of plastic tubes. The extra care required in their preparation, and in their reshaping after use, is more than offset by their relative permanence as compared with rubber. I would be most pleased to receive any information from users of " Portex " tubes concerning their experience with them.

Yours faithfully,

W. J. STEVENS
Gravesend

REVIEW

Clinical Uses of Intravenous Procaine. By DAVID J. GRAUBARD and MILTON C. PETERSON. 84 pp., 9 illustrations. Published by Blackwell Scientific Publications, Oxford. Price 8*s.* 6*d.*

The rapid strides being made in all realms of medicine and the wide horizons covered by those specialties which might appear to have a limited field have made the production of up-to-date text books impossible. The day a text book is published it becomes dated, and is already behind the times. The recognition of this fact has led publishers to favour monographs, which can be produced more quickly and are thus more likely to contain up-to-the minute information.

Messrs. Blackwell appear to have adopted this policy in regard to books on anæsthesia, and we have already had from this eminent house such best sellers as *Local Anæsthesia*, *Brachial Plexus*, *Anæsthesia in Operations for Goitre*, and *Anæsthesia for the Poor Risk*. The volume under review is such a monograph, and with the advancing interest in procaine and its many applications this volume should have a great attraction for anæsthetists. In it will be found reviewed the ever increasing scope of the therapeutic and anæsthetic uses of the drug, to which the authors have contributed significantly. An outstanding feature is the extremely comprehensive bibliography, which will make this a handy and complete book of reference. It is pleasing to find that what little work in this field has been

done on this side of the Atlantic is duly acknowledged and such an early pioneer as Morrison is given credit.

An innovation in this edition is the editing of the American text by a British authority (Dr. W. W. Mushin). One might question whether the American idiom is already so far removed from its roots that such an " imprimatur " was really necessary. However, it can do no harm and may make this authoritative little volume more acceptable to some readers.

MEETINGS AND REPORTS OF SOCIETIES

TWENTY-SIXTH ANNUAL CONGRESS OF ANÆSTHETISTS

THE 26th Annual Congress of Anæsthetists will be held in London from 3rd to 7th September, 1951.

Scientific papers will be delivered at British Medical Association House, Tavistock Square, London, W.C.1. Registration and the Manufacturers' Exhibition of drugs and apparatus will be at St. Pancras Town Hall, London, N.W.1. Special hospital clinics and demonstrations at many London hospitals have been arranged.

There will be a registration fee of £2 2*s*. which covers admission to scientific sessions, hospital clinics, various complimentary luncheons and receptions etc.

Copies of the programme may be obtained from The Congress Secretary, 25 Park Crescent, London, W.1, to whom all inquiries should be addressed.

THE SCOTTISH SOCIETY OF ANÆSTHETISTS

THE Scottish Society of Anæsthetists held their Annual Meeting at Dunblane Hydro, Perthshire, from Friday, April 27, to Sunday, April 29, 1951. The President, Dr. H. H. Pinkerton (Glasgow) delivered his Address on "General Anæsthesia for Collapse Therapy in Pulmonary Tuberculosis". Dr. T. J. C. MacDonald (Aberdeen) was elected Vice-President for the ensuing year. Other members of the Executive Council for 1951–52 are Dr. John Gillies (Edinburgh), Dr. W. M. Shearer (Dundee), Dr. L. G. Morrison (Edinburgh), Dr. J. D. Robertson (Edinburgh), Dr. I. M. C. Dewar (Glasgow), Dr. A. G. Miller (Glasgow), Dr. J. W. I. Bain (Aberdeen), and Dr. R. N. Sinclair (Glasgow), Hon. Secretary.

Dr. W. W. Mushin (Cardiff) was a guest of the Society, and gave a short and piquant talk which he entitled "The Null Hypothesis". The prize which the Scottish Society is awarding annually for the best paper submitted from a Registrar was won by Dr. J. G. Robson (Glasgow), who read a resumé of his paper on "Pethidine Supplementation of Nitrous Oxide and Oxygen Anæsthesia".

A company of 110, comprising members, their wives, and guests, were present at dinner on Saturday evening. Dancing, and a concert provided by Dr. W. Auld and members of the Orpheus Club, completed a successful occasion.